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ACT/007/018



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July 23, 1986

DIVISION OF
OIL, GAS & MINING

Ms. Sue Linner
Utah Division of
Oil, Gas & Mining
355 West North Temple
3 Triad Center, Suite 350
Salt Lake City, UT 84180

RE: Soldier Canyon Mine
Act/007/0018

Dear Ms. Linner:

Enclosed for your review and comment is a scope of work prepared by Sargent, Hauskins and Beckwith in response to discussions with Dave Cline and Dave Darby July 2, 1986. Please note that work will be initiated August 11, 1986; therefore, we request that any comments you might have be conveyed to us as soon as possible.

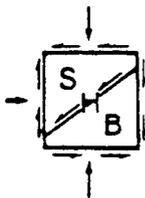
If you have questions please call me.

Very truly yours,

C.W. Durrett, Manager
Environmental Affairs

Enclosure:

CWD:aa



SERGEANT, HAUSKINS & BECKWITH

CONSULTING GEOTECHNICAL ENGINEERS

APPLIED SOIL MECHANICS • ENGINEERING GEOLOGY • MATERIALS ENGINEERING • HYDROLOGY

B. DWAIN SERGENT, P.E.
LAWRENCE A. HANSEN, PH.D., P.E.
RALPH E. WEEKS, P.G.
DARRELL L. BUFFINGTON, P.E.
DONALD VAN BUSKIRK, P.G.

JOHN B. HAUSKINS, P.E.
DALE V. BEDENKOP, P.E.
DONALD L. CURRAN, P.E.
J. DAVID DEATHERAGE, P.E.
MICHAEL R. RUCKER, P.E.

GEORGE H. BECKWITH, P.E.
ROBERT W. CROSSLEY, P.E.
DONALD G. METZGER, P.G.
JONATHAN A. CRYSTAL, P.E.
PAUL V. SMITH, P.G.

ROBERT D. BOOTH, P.E.
NORMAN H. WETZ, P.E.
ROBERT L. FREW
ALLON C. OWEN, JR., P.E.

July 14, 1986

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Sunedco Coal Co.
7401 West Mansfield Avenue
Suite 418
Lakewood, Colorado 80235

SHB Proposal No. 86-7-8

DIVISION OF
OIL, GAS & MINING

Attention: Mr. Charles W. Durrett, Manager
Environmental Affairs

Re: Supplemental Hydrogeologic Study
Soldier Canyon Mine
Carbon County, Utah

Gentlemen:

As addressed in our recent correspondence, the lack of sufficient hydrogeologic data concerning the conditions under the lowest coal seam slated for removal at the Soldier Canyon Mine has prompted us to recommend the completion of a supplemental investigation. The objective of this submittal is to describe the proposed scope of this investigative program, delineate our involvement with the field and office studies and present the Sergeant, Hauskins & Beckwith (SHB) personnel who would participate in investigation. An estimate of man-hours for the various phases of the program are presented herein. A cost estimate for SHB labor and associated direct costs is presented under separate cover.

1. Statement of Project Objectives

The Utah Division of Oil, Gas and Mining (UDOGM) recently issued a series of responses to the Soldier Canyon Mine permit application during its initial completeness review. To further define the concerns of UDOGM relative to the completeness of the subject application, a meeting was held with personnel of UDOGM, SHB and Sunedco Coal Co. (Sunedco) on July 2nd, 1986 in Salt Lake City. A concern was raised by UDOGM personnel relative to the probable hydrologic consequences of mining upon the water-bearing units underlying the Gilson coal seam. In response to this concern, we evaluated the available geologic information on the formations under the Gilson seam. It was determined that the hydrogeologic characteristics of the rock units lying below the Gilson seam were not known to a sufficient level of detail to adequately assess the potential for hydrologic impacts to the underlying regime. The scope of work discussed herein is designed to obtain a sufficient body of data in order that the hydrogeologic conditions can be analyzed and the probable hydrogeologic consequence can be identified.

REPLY TO: 3940 W. CLARENDON, PHOENIX, ARIZONA 85019

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2. Proposed Scope of Work

2.1 Field Investigation

The Soldier Creek Coal Company has drilled several boreholes from the present working level in the Rock Canyon seam through, but not below the Gilson coal seam. The underlying coal bed is located about 40 to 50 feet below the present working level. These boreholes are located throughout the active underground workings. It is understood that some of these borings may still be open in order that water levels could be obtained.

We propose to reenter three of these boreholes and core to depths ranging from 80 to 130 feet below the Gilson coal seam. The borehole locations would be selected in such a manner as to form a strong geometric figure for the determination of groundwater flow direction and gradient.

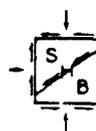
In detail, the following field activities would be completed by an experienced SHB geologist who would supervise the drilling operation and record the necessary data.

- Continuous logging of the rock core, including lithologic descriptions, RQD, percent core and water recovery, fracture frequency and orientations, condition of all discontinuities and drill rate.
- Measurements of depth-to-water in selected open boreholes throughout the accessible portions of the underground workings. Depth-to-water measurements in three coreholes completed for this project after bailing or air-lifting of drill waters.
- Supervise the completion of slug and/or packer hydrologic testing of selected intervals in the three coreholes.

We understand that Soldier Creek Coal Company will supply all the necessary drilling equipment and personnel required to complete the coring program. If we determine that our packer systems are compatible to your equipment and can be used in the confined underground work areas, we would provide these packers for unlimited use on the project.

2.2 Hydrologic Analyses & Reporting

Subsequent to the field program, we would analyze the hydrologic data, complete and formalize all the field information and present our findings in a formal report. In brief, these activities would include the following:



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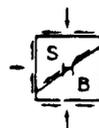
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- Analysis of slug testing measurements by methods proposed by Cooper and others (1967)⁽¹⁾ to estimate aquifer transmissivity.
- Analysis of packer testing measurements by methods presented by O'Rourke (1977)⁽²⁾ or U.S. Bureau of Reclamation (1974)⁽³⁾ to approximate hydraulic conductivities.
- Solution of 3-point problem to determine direction and gradient of groundwater flow.
- Presentation of formal corehole logs which depict all acquired lithologic, rock competency, weathering and fracturing data.
- A site plan showing the location of all data points.
- Geologic cross sections, if appropriate.
- Descriptions of hydrogeologic conditions, transmissivity, gradient, flow direction, etc.
- Analysis and discussion of probable hydrologic consequences of mining on the underlying water-bearing units; potential for transport of mine waters to underlying systems; potential for inflow to the mine working from the underlying units; possibility of intercepting substantial volumes of groundwater as mine reaches lower sectors to the north.

3. Proposed SHB Staffing Plan

We propose to assign three SHB geologists to the proposed field or office studies outlined herein. Mr. Ralph E. Weeks will act as SHB's project manager and administrate all technical activities. Mr. Michael R. Hulpke

-
- (1) Cooper, H.H., Bredehoeft, J.D. and Papadopoulos, I.S., 1967, Response of a Finite-Diameter Well to an Instantaneous Discharge of Water: Water Resources, Vol. 3, No. 1, p. 263-269.
- (2) O'Rourke, J.E., 1977, Field Permeability Test Methods with Applications to Solution Mining, U.S. Bureau of Mines Report No. OFR-136-77.
- (3) U.S. Department of Interior, Bureau of Reclamation, 1974, Earth Manual, 2nd Edition, U.S. Government Printing Office, Washington, D.C.



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will be involved on a review basis during the field program and subsequently assist in the hydrologic analyses. Mr. Hulpke is familiar with the hydrogeologic conditions in the area due to his past involvement with the compilation of the Soldier Creek permit application. Mr. Kenneth D. Donnelson will complete all field activities required. Resumes of the personnel described above are attached.

4. Man-Hour Estimate & Project Schedule

The following is our estimate of man-hour contributions for the various phases of the proposed study:

<u>Labor Category</u>	<u>Man-Hours</u>		
	<u>(A)</u>	<u>(B)</u>	<u>(C)</u>
Project Manager	1	4	4
Senior Geologist	2	2	6
Staff Geologist	4	80	20

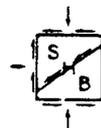
(A) Program Administration & field preparation.

(B) Field program.

(C) Analyses & reporting.

The above man-hour estimate is based upon your approximation that each borehole will take about one day to complete, with one day required to move the rig from one location to the next. All estimates also assume that the field program will be continued without interruption on a one shift per day basis.

As we previously discussed, we would mobilize our staff geologist to the site on Monday, August 11th, 1986. We assume that during his travel day to the site and subsequent orientation and safety training, the drill rig would be setting up on the first hole. If drilling was to commence on Tuesday morning the 12th, we approximate that the entire field program could be completed by Sunday, August 17th. We would be able to present a formal report by September 1st, 1986.



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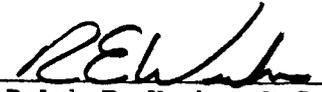
Supplemental Hydrogeologic Study
Soldier Canyon Mine
Carbon County, Utah
SHB Proposal No. 86-7-8

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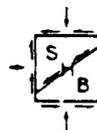
We trust that the above discussions are adequate in describing the scope of SHB's proposed activities on the project. Please feel free to contact us should any questions arise during your review of this submittal.

Respectfully submitted,
Sergent, Hauskins & Beckwith Engineers

By


Ralph E. Weeks, P.G.

Copies: Addressee (3)
Utah Division of Oil, Gas & Mining
Mined Land Reclamation Program
Attn: Mr. David Cline (1)



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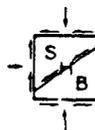
Ralph E. Weeks, P.G.
Chief Engineering Geologist - Vice President
Sergent, Hauskins & Beckwith
Geotechnical Engineers, Inc.

Mr. Weeks received his B.S. degree in Geology from Northern Arizona University in 1969, followed by one year of advanced studies in law and geology at Arizona State University during 1970. He has supplemented his professional experience in the past four years by attending several academic short courses in the field of groundwater hydrology and pollutant movement. Mr. Weeks is a registered geologist in the States of Arizona, California, Alaska, and Indiana and a certified member and past president of the Arizona section of the American Institute of Professional Geologists. He is also a certified water well driller in Arizona and a member of the Geological Society of America, the Association of Engineering Geologists, the National Water Well Association, and the American Geophysical Union.

As staff through chief geologist with SHB from 1969 to 1972 and since 1976, Mr. Weeks has acquired experience in project management, geological data acquisition and report preparation for multiple geotechnical and hydrogeological projects. Various responsibilities have included full supervision of field investigations, development of testing programs, budget and proposal preparation, liaison activities with consulting hydrologists and mining organizations, and research of geological and hydrogeological literature and data. Field functions have included the specialized mapping of lithology, fracture patterns and landslide features, the design of field permeability test programs, groundwater monitoring systems and water wells, and the logging and sampling of soil/rock formations by multiple borehole methods. Mr. Weeks is also experienced in the use of geophysical methods, shallow seismic refraction and resistivity surveys, and active fault studies with special reference to their application in site selection evaluations.

Mr. Weeks currently supervises a group of seven geologists in the Phoenix office of SHB, and coordinates geologic studies which are completed by the staff of other SHB offices. He acts in a comprehensive review capacity for all major reports which contain the results of geologic studies.

During his association with SHB, Mr. Weeks has had the opportunity to be involved in projects in Arizona, New Mexico, Nevada, Utah, Oregon, Montana, Wyoming, and Canada. These projects include site selection studies for mill-site and tailings disposal facilities, seismic and geomorphic hazard studies, hydrogeological evaluations for environmental impact water resource development, and geotechnical investigations of landslide hazards, railroad alignments, damsites, power and pipeline transmission systems, and industrial buildings. The following is a list of representative projects in which Mr. Weeks played a primary role:



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Ralph E. Weeks, P.G. (Cont'd.)

Geologic Hazard Evaluations
Uranium Mill Tailings Remedial Action Project
U.S. Department of Energy

Manager of geologic studies - geomorphic and seismic hazard evaluations for developing reclamation plans for 24 abandoned uranium tailings sites located throughout the western U.S.

Geohydrological Investigation
K-2 Potash Project
International Mineral Corp.
Esterhazy, Saskatchewan

Manager - study of brine contamination of groundwater caused by disposal of potash process wastes in 400-acre surface facility. Study included detailed hydrogeologic data compilation and computer modeling to predict future impacts and recommend remedial measures.

Hydrogeologic Evaluations
Gold Quarry Project
Newmont Mining Ltd.
Eureka County, Nevada

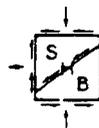
Manager - full supervision and execution of comprehensive hydrogeologic investigations to develop 2,000 gpm groundwater source for use in mill processing. Second element of evaluations: groundwater aquifer protection from 55-million ton capacity cyanide-laden tailings impoundment.

Hydrogeologic Evaluations
Navajo-Hopi Indian Reservation
Bureau of Indian Affairs
Arizona

Senior reviewer - primary input and review for groundwater resource exploration and predevelopment study. Program included extensive existing data interpretations and site selection process. Next phase to include exploration and geophysical surveys.

Geohydrological Evaluation
Cortez Gold Project
Placer Amex Inc.
Eureka County, Nevada

Manager - study of existing cyanide contamination of groundwater system. Investigation included installation of multiple monitoring wells, hydrological testing and 3-dimensional groundwater modeling to predict future impacts.



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Ralph E. Weeks, P.G. (Cont'd.)

Geotechnical and earthquake evaluation studies
Jerritt Canyon Project - Freeport Gold Company
Elko County, Nevada

Assistant manager and technical participant - geotechnical exploration and analysis, and active fault studies involving regional evaluation, low-sun-angle reconnaissance and photography, and photogeologic analysis for siting and design of 17 million ton tailings disposal facility.

Earthquake evaluation studies
Espanola Basin Flood Control Dams
U.S. Soil Conservation Service
Rio Grande Rift, New Mexico

Manager and technical participant - regional and site specific studies of earthquake potential; project included low-sun-angle photo acquisition, photogeologic analysis, trenching program and evaluation of surface rupture potential and design earthquake parameters.

Geotechnical design development studies
Schoens Flood Control Dam
Navajo County, Arizona

Project geologist - assessment of 33,000 acre-foot capacity flood control structure. Studies included remote sensing imagery analysis and detailed dam foundation mapping.

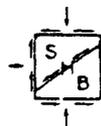
Geohydrological studies for submission of discharge plan
Copper Flats Project
Quintana Minerals
Sierra County, New Mexico

Manager - hydrological evaluation to determine potential water quality effects of future disposal of 20 million tons of copper tailings. Study included monitoring well installations, hydrological testing and baseline water quality determinations.

Subsidence and earth fissuring evaluation
McMicken Flood Control Dam
Maricopa County, Arizona

Project geologist - analysis of existing ground subsidence and fissuring due to groundwater withdrawal. Studies included acquisition and review of low-sun-angle aerial photography and development of remedial measures to restore 9-mile long dam to service.

During previous work for H. Coiner and Associates in Salmon, Idaho and L.H. Bell & Associates in Phoenix, Arizona, Mr. Weeks acquired three years of



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Ralph E. Weeks, P.G. (Cont'd.)

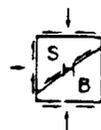
experience as a civil engineering designer and survey party chief. Responsibilities included design, field layout and construction control for urban subdivisions, municipal utilities, roads and flood control facilities. Design phases of his work included engineering computer applications and project administration.

Publications

Weeks, R.E. and Hansen, L.A. (in press), "Restoration of McMicken Dam - Repairing the Effects of Ground Subsidence & Protecting Against Earth Fissuring", Arizona Bureau of Geology & Mineral Technology special publication.

Gillam, M.L. and Weeks, R.E., 1984, "Evaluating Geomorphic Hazards from River Behavior - Durango, Riverton & Gunnison UMTRA Sites", proceedings of the 7th Symposium on Management of Uranium Mill Tailings, Low Level Waste and Hazardous Waste, Colorado State University, Fort Collins, Colorado.

Hansen, L.A., Weeks, R.E. & Shrestha, R.K., 1983, "Evaluation of On-Site Soil for Use as an Impoundment Liner", Hazardous & Industrial Solid Waste Testing: Second Symposium, ASTM STP 805, R.A. Conway & W.P. Gulledge, Eds., American Society for Testing & Materials, p. 231-245.



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Michael R. Hulpke, G.I.T.
Staff Geologist
Sergent, Hauskins & Beckwith
Geotechnical Engineers, Inc.

Mr. Hulpke received his B.S. degree in Geology from Northern Arizona University in 1974. He has supplemented his professional experience by attending several short courses in the field of hydrogeology and corrective actions for groundwater contamination. He is a member of the Geological Society of America and the National Water Well Association. Mr. Hulpke is a certified geologist-in-training in the State of Arizona.

Since joining the firm in 1977, Mr. Hulpke has gained experience in the supervision of geotechnical and hydrogeologic field investigations, compilation and research of geologic literature and data, and preparation of report input for site characterization. Field functions have included logging and sampling of soil/rock formations by multiple borehole methods, pump and infiltration testing for hydrogeologic determinations, geologic mapping, application of seismic refraction, gravimetric, conductivity, and resistivity geophysical methods, water quality sampling and testing and aggregate source evaluations.

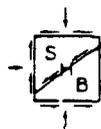
During his association with SHB, Mr. Hulpke has had the opportunity to be involved with projects in Arizona, New Mexico, Wyoming, Oregon, Montana, Idaho, California, Utah and Nevada. These projects have included site selection, geotechnical and hydrogeologic evaluations for millsites, industrial buildings, coal ash and tailings disposal facilities, corridor studies for power transmission and railroad alignments, flood control and leachate retention dams and hydrogeologic evaluations during the preparation of permit applications for coal mining projects. The following list enumerates several significant projects:

Geologic and hydrogeologic evaluation
and preparation of permit application.
Soldier Canyon Mine Project
Carbon County, Utah

Geologic and hydrogeologic evaluation.
Sunnyside Coal Project
Carbon County, Utah

Design and supervision of field program,
hydrological testing and installation
of dewatering well array.
Northeastern Nevada

Field supervision installation and test
pumping of test wells and production well.
Gold Quarry Project
Eureka County, Nevada



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Michael R. Hulpke, G.I.T. (Cont'd.)

Field supervision installation of monitoring well array.

Golden Sunlight Project
Jefferson County, Montana

Geologic and hydrogeologic evaluations, mapping, and site selection for leachate retention dams.

Gold Gulch Project - Pinto Valley Operations
Gila County, Arizona

Supervision of field exploration program, mapping and hydrologic testing for site selection of tailings disposal facility.

Jerritt Canyon Project
Elko County, Nevada

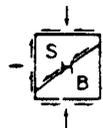
Geotechnical field studies of power transmission corridor and ash disposal system.

Springerville Power Plant
Apache County, Arizona

Field supervision of exploration program, detailed hydrologic testing and aggregate source evaluations for uranium milling site selection analysis.

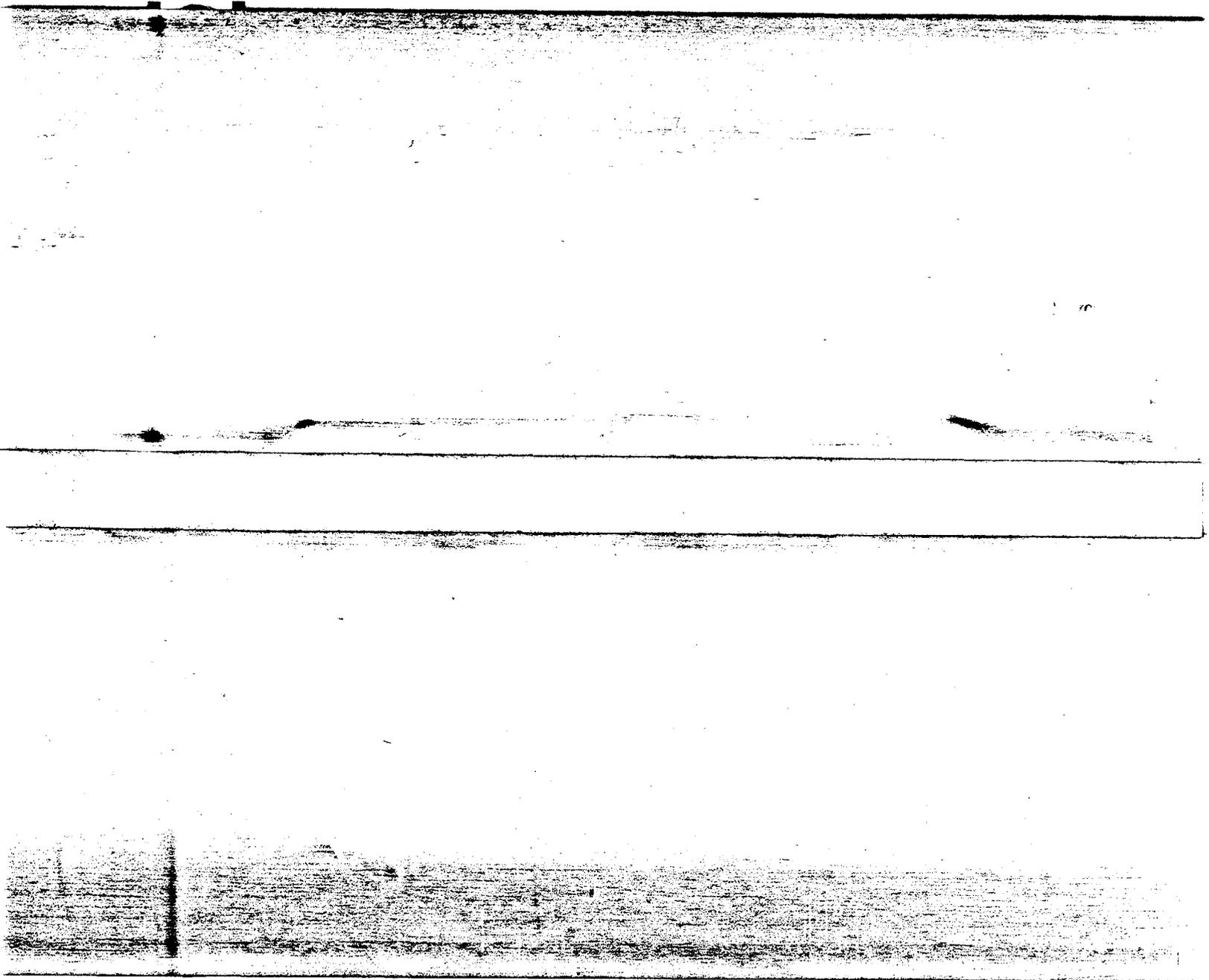
Aurora Joint Venture
Malheur County, Oregon

Prior to joining SHB, Mr. Hulpke was employed by Dresser/Magcobar, and gained one year of experience in the supervision and maintenance of electronic monitoring for oil and gas exploration, as well as downhole logging and preparation of lithologic logs during deep drilling operations.



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Kenneth D. Donnelson
Staff Geologist
Sergent, Hauskins & Beckwith
Geotechnical Engineers, Inc.

Education: B.S. Geology, University of Nevada, Reno, 1969.

Registered Professional Geologist: Registered in Georgia.

Professional Experience: Sergent, Hauskins & Beckwith Geotechnical Engineers, Inc. (SHB), January 1985 to present. Mr. Donnelson joined SHB in January of 1985, and has gained experience in the supervision of geotechnical field investigations and report writing. Field functions have included logging and sampling of soil and rock formations, permeability testing, installation, development and testing of monitoring wells, landslide mapping, geologic mapping, supervising grouting program, and sampling and evaluations of clay and gravel sources.

During his association with SHB, Mr. Donnelson has had the opportunity to be involved in projects in Arizona, California, Nevada, Utah and Texas. These projects have included supervising subsurface investigations for dump leach piles, buildings, storage tanks, transmission lines and pump stations, supervising monitoring well installation to measure possible uranium contamination, supervising grouting for solution retention dam, and performing clay and aggregate source evaluation for pond liner and filter material, respectively. The following list enumerates several significant projects:

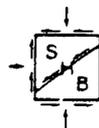
Geotechnical Evaluations
Sewage Treatment Pond
Green Valley Wastewater Treatment Facility
Green Valley, Arizona

Technical participant-geotechnical field investigation of seepage through dike by exploratory drilling.

Geotechnical Evaluations
Southwest and Outer Loop Highways
Arizona Department of Transportation
Phoenix, Arizona

Technical participant-geotechnical field investigation for proposed highways. Work included literature search and geologic mapping.

Water Quality Evaluations
Uranium Mill and Tailings Remedial Action Project
Department of Energy
Monument Valley, Arizona, Mexican Hat, Utah and Fall City Texas



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Kenneth D. Donnelson
Staff Geologist
Sergent, Hauskins & Beckwith
Geotechnical Engineers, Inc.

Field Technical Representative - supervise installation and development of monitoring wells near uranium tailings piles. Collected water samples and measured for conductivity, pH and sulfate. Field work also included logging drill hole cuttings and interpreting geophysical well logs.

Geotechnical Evaluations
230KV Transmission Line
Salt River Project
Phoenix, Arizona

Project Geologist - geotechnical field and office investigation for 31 miles of proposed transmission line. Field work included exploratory drilling and geologic mapping.

Geotechnical Evaluations
Dump Leach Pile
Magma Copper Company
San Manuel, Arizona

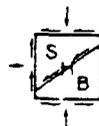
Project Geologist - geotechnical field and office investigation of proposed dump leach pad adjacent to block caved area. Field work included exploratory drilling and test pits, permeability testing, bulk sampling and geologic mapping. Office work included reviewing company data on borings, geology, geophysics, hydrology and mining, and evaluating seismic hazards.

Geotechnical Evaluations
Dump Leach Pile
Gold Quarry Project
Carlin Gold Mining Company
Carlin, Nevada

Technical participant - geotechnical field investigation of proposed dump leach pad. Field work included exploratory drilling and test pits, permeability testing, and clay borrow and aggregate source evaluations. Also, mapping of landslide in area of existing leached residue dump site.

Grouting Program
Solution Retention Dam
Inspiration Consolidated Copper Company
Miami, Arizona

Field control - conducted test grouting program in decomposed granite. Field work included documenting grout quantities and performing packer tests.



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Kenneth D. Donnelson
Staff Geologist
Sergent, Hauskins & Beckwith
Geotechnical Engineers, Inc.

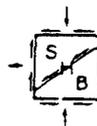
Geotechnical Evaluations
Pump Station
All American Pipeline
Cadiz Lake, California

Technical participant - geotechnical field investigation of proposed pump station and storage tanks. Field work included exploratory drilling.

Prior to joining SHB, Mr. Donnelson was employed by Eisenman Chemical Company in Elko, Nevada as an exploration and mining geologist for barite deposits. This work included evaluating barite, bentonite and hematite properties by geologic mapping, drilling and geophysical survey.

From 1972 to 1981, Mr. Donnelson was employed by Bechtel Civil & Minerals as an engineering geologist at their Los Angeles, San Francisco and Gaithersburg, Maryland offices. He gained extensive geotechnical experience working for Bechtel on projects in Alabama, Arizona, Florida, Maryland, Massachusetts, New Mexico, New York, Oregon, Texas, Utah, Virginia, Virgin Islands, Washington and Washington, D.C. These projects have included supervising subsurface investigations and conducting site selections for power plants, dams, railroad routes, ponds and tunnels, supervising installation and monitoring instrumentation for measuring movement about tunnels and excavations, evaluating aggregate, ballast, lignite, riprap, limestone, coal and clay sources, and performing permeability and pump tests.

Prior to joining Bechtel, Mr. Donnelson was employed by the geological consulting firm of Hall, Relph and Associates in Sydney, Australia as an exploration geologist, primarily involved in the search for uranium.



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